

UTILITY PATENT
APPLICATION TRANSMITTAL

(Only for new nonprovisional applications
under 37 CFR 1.53(b))

Attorney Docket No.

000296

Total Pages

First Named Inventor or Application Identifier

Mitsuo SUEHIRO

Express Mail Label No.

Check Box, if applicable [] Duplicate

APPLICATION ELEMENTS FOR:

**PRINTED CIRCUIT BOARD UNIT WITH
DETACHMENT MECHANISM FOR ELECTRONIC
COMPONENT**

ADDRESS TO: Assistant Commissioner for Patents
BOX PATENT APPLICATIONS
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1. [XX] Fee Transmittal Form (Incorporated within this form)
(Submit an original and a duplicate for fee processing)

2. [XX] Specification Total Pages [19]

3. [XX] Drawing(s) (35 USC 113) Total Sheets [8]

4. [XX] Oath or Declaration Total Pages [4]

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[] Copy from prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed).

i. [] Deletion of Inventor(s)

Signed statement attached deleting inventor(s) named in prior application,
see 37 CFR 1.63(d)(2) and 1.33(b).

5. [] Incorporation by reference (useable if box 4b is checked)

The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under
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6. [] Microfiche Computer Program (Appendix)

7. [] Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)

a. [] Computer Readable Copy

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c. [] Statement Verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [XX] Assignment Papers (cover sheet and document(s))

9. [] 37 CFR 3.73(b) Statement (when there is an assignee) [XX] Power of Attorney

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10. ☐ English translation Document (if applicable)

11. ☐ Information Disclosure Statement ☐ Copies of IDS Citations

12. ☐ Preliminary Amendment

13. ☒ Return Receipt Postcard (MPEP 503)

14. ☐ Small Entity Statement(s) ☐ Statement filed in prior application
Status still proper and desired.

15. ☒ Claim for Convention Priority ☐ Certified copy of Priority Document

a. Priority of _____ application no. _____ filed on _____ is claimed under 35 USC 119.

The certified copies/copy have/has been filed in prior application Serial No. _____.

(For Continuing Applications, if applicable).

16. ☐ Other _____

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

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| The filing fee is calculated below | | | | \$690.00 |
| Total Claims | 15 - 20 | | x \$18.00 | |
| Independent Claims | 3 - 3 | | x \$78.00 | |
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Date: March 29, 2000

REN/yap

SPECIFICATION

PRINTED CIRCUIT BOARD UNIT WITH DETACHMENT MECHANISM FOR ELECTRONIC COMPONENT

BACKGROUND OF THE INVENTION

Field of the Invention:

The present invention relates to a printed circuit board unit comprising a printed circuit board and an electronic component such as a chip mounted on the surface of the printed circuit board through solders.

Description of the Prior Art:

Soldering is often employed to mount electronic components such as semiconductor devices or bare chips on a printed circuit board in a multi-chip module (MCM) or a semiconductor package. Soldering is also employed to mount electronic components such as the MCMs on a printed circuit board of a larger size, namely, a motherboard. When the individual bare chip or MCM is to be exchanged in the MCM or motherboard, solders must be broken or removed to release bonding between input/output terminals on the bare chip or the MCM and input/output pads arranged on the printed circuit board. For example, an exchanging operation is designed to detach the older bare chip or MCM from the printed circuit board when the solders are subjected to heat of temperature higher than the melting point of the solders. A new bare chip or MCM is thereafter mounted on the printed circuit board by soldering input/output terminals of the new bare chip or MCM to the input/output pads which have previously received the input/output terminals of the old bare chip or MCM.

It is well known that part of the old solder still remains

on the input/output pad on the printed circuit board even after the old bare chip or MCM is detached in the above-described exchanging operation. When a new bare chip or MCM is mounted on the printed circuit board, a new solder of a predetermined amount is added to the old solder remaining on the input/output pad. An excessive solder may induce a short between the adjacent input/output terminals.

In particular, the respective input/output pads are not expected to keep solders of a uniform amount remaining thereon. When a bare chip or MCM employs a plurality of input/output terminals such as a ball grid array (BGA) and a pin grid array (PGA), the bare chip or MCM may suffer from the solders of a varied height on the input/output pads. The input/output terminals of the new bare chip or MCM may in part fail to touch the surface of the input/output pads on the printed circuit board. No electric connection can thus be achieved partly.

In view of the above inconvenience, the solders remaining on the input/output pads should be wiped out before a new bare chip or MCM is mounted. For example, the printed circuit board along with the remaining bare chips or MCMs is subjected to another heat so as to melt the solders remaining on the input/output pads. Heat is sometimes repeatedly applied to the printed circuit board more than twice until the solders are completely wiped out. Repeated application of heat is supposed to damage and shorten the life of the printed circuit board, and bare chips or MCMs remaining on the printed circuit board. It sometimes deteriorates the wetness of the input/output pads to solders.

SUMMARY OF THE INVENTION

It is accordingly an object of the present invention to

provide a printed circuit board capable of avoiding repeated application of heat even when an electronic component is exchanged.

According to the present invention, there is provided a printed circuit board unit comprising: a printed circuit board; an electronic component; a solder bump interposed between the printed circuit board and the electronic component so as to fix the electronic component to the printed circuit board; and an insulated film disposed between the printed circuit board and the electronic component so as to define a through hole for receiving the solder bump.

With the above structure, electric connection can reliably be established between the printed circuit board and the electronic component since the solder bump is allowed to penetrate through the through hole in the insulated film disposed between the printed circuit board and the electronic component. The insulated film is highly expected to contribute to detachment of the electronic component from the printed circuit board.

For example, the through hole may be designed to form a constriction in the solder bump between the printed circuit board and the electronic component. When the insulated film is brought away from the printed circuit board, the insulated film serves to tear the solder bump in two pieces at the constriction, so that the electronic component can easily be detached from the printed circuit board.

In this case, the insulated film is preferably superposed on the printed circuit board so as to form the constriction right on a conductive pad on the printed circuit board. Such constriction serves to allow the solder bump of a constant amount to remain on the conductive pad, so that a plurality of

solder bumps of a uniform amount are allowed to remain on the corresponding conductive pads. The thinner the insulated film gets, the less the solder bump remains on the conductive pad.

Such a through hole, standing on the conductive pad so as to form the constriction in the solder bump, may have the inner peripheral size smaller than the outer peripheral size of the conductive pad. Such a through hole may serve to prevent the melting solder bump from flowing off the periphery of the surface of the conductive pad. In general, the conductive pad usually comprises a base conductive layer on a substrate of the printed circuit board, and a surface conductive layer superposed on the top surface of the base conductive layer. The surface conductive layer is designed to have a corrosion resistance higher than the base conductive layer. If the solder bump is prevented from flowing around the surface conductive layer so as to reach the base conductive layer in the above manner, it is possible to reliably avoid erosion of the base conductive layer such as a copper layer. The base conductive layer is prevented from getting thinner or smaller. The surface conductive layer may be a nickel layer.

When the electronic component is to be detached from the printed circuit board, the through hole may be displaced along the surface of the conductive pad. The solder bump should be kept at a melting temperature. The sliding movement of the insulated film along the surface of the printed circuit board serves to completely wipe out the melting solder bump from the conductive pad. The solder bump is torn apart. Moreover, the solder bump hardly remains on the surface of the conductive pad.

Furthermore, the inner surface of the through hole may be covered with a coating wet to the solder bump. In detaching the electronic component from the printed circuit board in this

case, a relative movement may be caused between the conductive pad and the through hole while the solder bump is kept at a melting temperature. When the inner surface of the through hole moves across the solder bump, the melting solder bump is dragged by the coating having a higher wetness to the solder bump. The solder bump can be removed.

Furthermore, the thickness of the insulated film may be designed to correspond to the height of the solder bump on the printed circuit board. Such an insulated film serves to surround the solder bump, received on the conductive pad, within the inner wall of the through hole. In detaching the electronic component from the printed circuit board, a relative movement may be caused between the conductive pad and the through hole while the solder bump is kept at a melting temperature. The inner wall of the through hole is designed to completely wipe out the solder bump from the conductive pad. Moreover, the solder bump hardly remains on the surface of the conductive pad.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become apparent from the following description of the preferred embodiments in conjunction with the accompanying drawings, wherein:

Fig. 1 is a plan view schematically illustrating a multi-chip module (MCM) according to a first embodiment of the present invention;

Fig. 2 is an enlarged partial sectional view of the MCM for illustrating the structure of a solder bump;

Fig. 3 is an enlarged partial sectional view of the MCM for illustrating a method of mounting the MCU on the printed circuit board;

Fig. 4 is an enlarged partial sectional view of the MCM for illustrating the method of mounting the MCU on the printed circuit board;

Fig. 5 is an enlarged sectional view illustrating the structure of an input/output pad on the printed circuit board;

Fig. 6 is an enlarged partial sectional view of the MCM of the first embodiment for illustrating a method of detaching the MCU from the printed circuit board according to a specific example;

Fig. 7 is an enlarged partial sectional view of the MCM of the first embodiment for illustrating a subsequent method of detaching the MCU from the printed circuit board according to the specific example;

Fig. 8 is an enlarged partial sectional view of the MCM of the first embodiment for illustrating a method of detaching the MCU from the printed circuit board according to another specific example;

Fig. 9 is an enlarged partial sectional view of the MCM of the first embodiment for illustrating a subsequent method of detaching the MCU from the printed circuit board according to the another specific example;

Fig. 10 is an enlarged sectional view schematically illustrating a part of an MCM according to a second embodiment of the present invention;

Fig. 11 is an enlarged partial sectional view of the MCM of the second embodiment for illustrating a method of detaching the MCU from the printed circuit board according to a specific example;

Fig. 12 is an enlarged partial sectional view of the MCM of the second embodiment for illustrating a subsequent method of detaching the MCU from the printed circuit board according

to the specific example;

Fig. 13 is an enlarged partial sectional view of the MCM of the second embodiment for illustrating a method of detaching the MCU from the printed circuit board according to another specific example;

Fig. 14 is an enlarged partial sectional view of the MCM of the second embodiment for illustrating a subsequent method of detaching the MCU from the printed circuit board according to the another specific example;

Fig. 15 is an enlarged partial sectional view of the MCM of the second embodiment for illustrating a method of detaching the MCU from the printed circuit board according to a further specific example;

Fig. 16 is an enlarged partial sectional view of the MCM of the second embodiment for illustrating a subsequent method of detaching the MCU from the printed circuit board according to the further specific example;

Fig. 17 is an enlarged sectional view of the MCM for schematically illustrating an insulated film as a seal member for the solder bumps;

Fig. 18 is an enlarged sectional view schematically illustrating a part of an MCM according to a third embodiment of the present invention;

Fig. 19 is an enlarged partial sectional view of the MCM of the third embodiment for illustrating a method of detaching the MCU from the printed circuit board according to a specific example; and

Fig. 20 is an enlarged partial sectional view of the MCM of the third embodiment for illustrating a subsequent method of detaching the MCU from the printed circuit board according to the specific example.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 illustrates a multi-chip module (MCM) as a printed circuit board unit according to a first embodiment of the present invention. The MCM 10 comprises a printed circuit board 13, and a plurality of semiconductor devices or bare chips, such as a micro controller unit (MCU) 11 and central processing units (CPUs) 12, mounted on the printed circuit board 13. A conductive pattern or printed circuit pattern, not shown, is formed on the printed circuit board 13 so as to electrically connect the MCU 11 and the CPUs 12, for example. The conductive pattern may spread over the surface of the printed circuit board 13, or interposed between layers of insulator sequentially superposed to form the substrate of the printed circuit board 13.

As is apparent from Fig. 2, a conductive pad or input/output pad 15 is formed on the surface of the printed circuit board 13 so as to receive a solder bump 14. The input/output pad 15 may be integral to the aforementioned conductive pattern over the surface of the printed circuit board 13. Otherwise, the input/output pad 15 may be connected to the aforementioned conductive pattern by a conductive via, for example. The solder bump 14 is designed to receive an input/output terminal or terminal pad 16 arranged on the rear surface of the MCU 11. The solder bump 14 serves to fix or bond the MCU 11 on the printed circuit board 13.

An insulated film 17 is disposed between the surface of the printed circuit board 13 and the MCU 11. The insulated film 17 may be made from polyimide, for example. The thickness of the insulated film 17 is set in a range of 5-10 μ m while the solder bump 14 has a height of approximately 70 μ m. Such height can

be measured in the vertical direction upright to the surface of the printed circuit board 13. The insulated film 17 is superposed on the surface of the input/output pad 15. A through hole 18 is defined or provided in the insulated film 17 so as to receive the solder bump 14. The through hole 18 is designed to define or form a constriction 14a in the solder bump 14 between the MCU 11 and the printed circuit board 13 since the inner peripheral size or inner diameter of the through hole 18 is set smaller than the outer peripheral size or outer diameter of the solder bump 14.

When the MCU 11 is mounted on the printed circuit board 13 in the MCM 10, the insulated film 17 is first superposed on the surface of the printed circuit board 13, as shown in Fig. 3. The input/output pads 15 are exposed at the surface of the printed circuit board 13. The through holes 18 have previously been formed in the insulated film 17. An excimer laser may be employed to bore the insulated film 17, for example. The position of the through holes 18 is set to correspond to arrangement of the input/output pads 15. When the insulated film 17 is superposed on the printed circuit board 13, the through hole 18 is designed to define a column space standing upright on the surface of the input/output pad 15, as is apparent from Fig. 3.

The MCU 11 is thereafter set on the surface of the insulated film 17. The MCU 11 has previously been provided with solder bumps 14 on the respective terminal pads 16. When the terminal pads 16 on the rear surface of the MCU 11 is aligned with the corresponding input/output pads 15 on the printed circuit board 13, the solder bumps 14 are adapted to close the upper openings of the corresponding through holes 18, respectively, as shown in Fig. 4. After the MCU 11 has been

set on the printed circuit board 13 in this manner, the printed circuit board 13 is introduced in a furnace for a heat treatment. The solder bumps 14 melt under the atmosphere of a melting temperature to thereby flow into the corresponding through holes 18. When the printed circuit board 13 is taken out of the furnace and cooled, the solder bumps 14 get hardened on the surface of the input/output pads 15, as shown in Fig. 2.

The input/output pad 15 comprises, for example, a circular copper layer 21 on the surface of the synthetic resin or ceramic substrate, a circular nickel layer 22 superposed on the top surface of the copper layer 21, and a gold layer 23 superposed on the top surface of the nickel layer 22, as shown in Fig. 5. If a solder containing tin contacts the copper layer 21, a higher temperature of the heat treatment may induce absorption of the copper layer 21 into the solder. The nickel layer 22 serves prevent such erosion of the copper layer 21. If the inner peripheral size or inner diameter of the through hole 18 is set smaller than the outer peripheral size or outer diameter of the surface of the input/output pad 15 in the above-described manner, the through hole 18 serves to reliably prevent the melting solder bump 14 from reaching the copper layer 21 by flowing around the nickel layer 22. The copper layer 21 can reliably be prevented from erosion and getting thinner or smaller.

When any defect of the MCU 11 is found in the MCM 10, the MCU 11 is preferably replaced with a new MCU 11. When the version of an installed software should be updated, the MCU 11 of the old version may be replaced with an MCU 11 of the new version. In any event, such exchange of the individual MCUs 11 may contribute to reuse of the printed circuit board 13 and the remaining electronic components such as the CPUs 12 mounted

on the printed circuit board 13.

When the MCU 11 is to be exchanged, the old MCU 11 is first detached from the printed circuit board 13. In detachment, a heat block 24 is first allowed to contact the MCU 11, as shown in Fig. 6, for example. The MCU 11 is supposed to transmit heat from the heat block 24 to the solder bump 14. The solder bump 14 is caused to melt. The MCU 11 is then lifted above the printed circuit board 13, so that the solder bump 14 is torn between the input/output pad 15 and the terminal pad 16. The bonding can be released in this manner between the MCU 11 and the printed circuit board 13.

When the MCU 11 has been lifted, the solder bump 14 sometimes can completely be removed from the input/output pad 15 on the printed circuit board 13. Part of the solder bump 14 may sometimes remain on the input/output pad 15. When the insulated film 17 is then lifted and brought away from the printed circuit board 13, as shown in Fig. 7, the solder bump 14 is further torn in two pieces at the constriction 14a. The constriction 14a is only allowed to remain on the input/output pad 15. The solder bumps 14 of a uniform amount are expected to remain on the respective input/output pads 15.

After the solder bumps 14 are removed in the aforementioned manner, the input/output pads 15 are allowed to receive solder bumps 14 of a new MCU 11. Since the old solder bumps 14 of a uniform amount remain, all of the solder bumps 14 of the new MCU 11 are expected to contact the corresponding input/output pads 15. All signal paths corresponding to the respective solder bumps 14 are reliably established between the conductive pattern on the printed circuit board 13 and the MCU 11.

It should be noted that the MCU 11 may be detached from

the printed circuit board 13 at the same time when the insulated film 17 is detached from the input/output pads 15. In addition, the insulated film 17 may be detached from the input/output pads 15, while the solder bumps 14 are kept melting, or after the solder bumps 14 get hardened.

Alternatively, when the MCU 11 is detached from the printed circuit board 13 in the MCM 10, as shown in Fig. 8, the through hole 18 may be displaced along the surface of the input/output pad 15 while the solder bump 14 is kept at a melting temperature, for example. The sliding movement of the insulated film 17 along the surface of the printed circuit board 13, keeping contact of the heat block 24 with the MCU 11, serves to completely wipe out the melting solder bump 14 from the input/output pad 15. When the MCU 11 is thereafter lifted up, as shown in Fig. 9, the MCU 11 holding the solder bump 14 can be detached from the printed circuit board 13. The solder bump 14 hardly remains on the input/output pad 15.

Fig. 10 illustrates a part of an MCM 31 according to a second embodiment of the present invention. As is apparent from Fig. 10, the thickness d of the insulated film 17 is set to correspond to the height of the solder bump 14 in this embodiment. In addition, the solder bump 14 is surrounded by the inner surface or wall of the through hole 18 since the inner peripheral size or inner diameter of the through hole 18 is set larger than the outer peripheral size or outer diameter of the solder bump 14. It should be noted that the like reference numerals are attached to structure or components achieving the function or advantages identical to those in the above-described first embodiment.

When the MCU 11 is to be detached from the printed circuit board 13 in the MCM 31, the inner wall of the through hole 18

may be displaced along the surface of the terminal pad 16 while the solder bump 14 is kept at a melting temperature, for example. As shown in Fig. 11, the sliding movement of the MCU 11 along the stationary insulated film 17, keeping contact of the heat block 24 with the MCU 11, serves to hinder the terminal pad 16 on the MCU 11 from dragging the melting solder bump 14. As a result, the solder bump 14 is torn off from the terminal pad 16 of the MCU 11, as shown in Fig. 12. After the MCU 11 has been detached from the printed circuit board 13, the solder bump 14 hardly remains on the terminal pad 16 on the MCU 11. Accordingly, the MCU 11 can easily be reused without additional operation for removing the solder bump 14 from the terminal pad 16. In particular, such method is most useful when an electronic component is to be detached in a semiconductor package. Such a semiconductor package in general employs a single bare chip, more expensive than the printed circuit board 13 or the remaining electronic components on the printed circuit board 13.

On the other hand, the printed circuit board 13 may be slid along the insulated film 17, for example, so as to achieve the displacement of the through hole 18 relative to the surface of the input/output pad 15, as shown in Fig. 13, while the heat block 24 is maintained on the stationary MCU 11. In this case, the inner wall of the through hole 18 serves to hinder the input/output pad 15 on the printed circuit board 13 from dragging the melting solder bump 14. As a result, the solder bump 14 is torn off from the input/output pad 15 of the printed circuit board 13, as shown in Fig. 14. After the MCU 11 has been detached from the printed circuit board 13, the solder bump 14 hardly remains on the input/output pad 15 on the printed circuit board 13. Accordingly, the printed circuit board 13

can easily be reused without additional operation for removing the solder bump 14 from the input/output pad 15. In addition, if the insulated film 17 is slid simultaneously relative to the MCU 11 and the printed circuit board 13, as shown in Figs. 15 and 16, the solder bump 14 can be wiped out from the terminal pad 16 on the MCU 11 and the input/output pad 15 on the printed circuit board 13, respectively. It should be noted that the insulated film 17 employed in the above-described MCM 31 may be utilized as a sealing member for the solder bumps 14, as shown in Fig. 17.

Fig. 18 illustrates a part of an MCM 41 according to a third embodiment of the present invention. In this embodiment, the inner surface of the through hole 18 is covered with a coating 42 which having a higher wetness to the solder bump 14. Note that the like reference numerals are attached to structure or components achieving the function or advantages identical to those in the above-described first and second embodiments.

When the MCU 11 is to be detached from the printed circuit board 13 in the MCM 41, the inner wall of the through hole 18 may be displaced along the surface of the input/output pad 15 while the solder bump 14 is kept at a melting temperature, for example. In this case, the insulated film 17 may, not only contact the terminal pad 16 on the MCU 11 and the input/output pad 15 on the printed circuit board 13, but also keep spaced from the terminal and the input/output pad 16, 15. As shown in Fig. 19, when the insulated film 17 is moved relative to the stationary MCU 11 and printed circuit board 13 in the horizontal direction, for example, keeping contact of the heat block 24 with the MCU 11, the coating 42 serves to drag the melting solder bump 14. The solder bump 14 is torn off simultaneously from the terminal pad 16 of the MCU 11 and the input/output pad 15

on the printed circuit board 13. Moreover, since the solder bump 14 is expected to held on the insulated film 17, as shown in Fig. 20, the solder bump 14 can easily be collected.

It should be noted that the present invention can be applied not only to the above-described MCMs 10, 31, 41 but also to any type of printed circuit board unit such as a motherboard comprising MCMs and other electronic components mounted on a printed circuit board. Heat air may be employed to allow solder bumps to melt between the MCMs and other electronic components and the printed circuit board of a larger size, for example, as is conventionally known. Moreover, the present invention may be applied not only to a ball grid array (BGA) such as the aforementioned MCMs 10, 31, 41 but also to any type of solder bonding such as a pin grid array (PGA), a lead frame, and the like.

WHAT IS CLAIMED IS:

1. A printed circuit board unit comprising:
a printed circuit board;
an electronic component;
a solder bump interposed between the printed circuit board and the electronic component so as to fix the electronic component to the printed circuit board; and
an insulated film disposed between the printed circuit board and the electronic component so as to define a through hole for receiving the solder bump.
2. The printed circuit board unit according to claim 1, wherein the through hole is designed to form a constriction in the solder bump between the printed circuit board and the electronic component.
3. The printed circuit board unit according to claim 2, wherein the insulated film is superposed on the printed circuit board so as to form the constriction right on a conductive pad on the printed circuit board.
4. The printed circuit board unit according to claim 3, wherein the conductive pad comprises a base conductive layer on a substrate of the printed circuit board, and a surface conductive layer having a corrosion resistance higher than the base conductive layer and superposed on a top surface of the base conductive layer.
5. The printed circuit board unit according to claim 4, wherein the base conductive layer is a copper layer.

6. The printed circuit board unit according to claim 5, wherein the surface conductive layer is a nickel layer.

7. The printed circuit board unit according to claim 1, wherein an outer peripheral size of the solder bump is set smaller than an inner peripheral size of the through hole.

8. The printed circuit board unit according to claim 7, wherein an inner surface of the through hole is covered with a coating wet to the solder bump.

9. The printed circuit board unit according to claim 7, wherein a thickness of the insulated film corresponds to a height of the solder bump on the printed circuit board.

10. A method of detaching an electronic component from a printed circuit board, comprising causing a relative movement between a conductive pad, disposed on the printed circuit board for receiving a solder bump under the electronic component, and a through hole defined in an insulated film for forming a constriction in the solder bump.

11. The method of detaching according to claim 10, wherein the insulated film is lifted up from the conductive pad on the printed circuit board.

12. The method of detaching according to claim 10, wherein the insulated film is driven to slide on the conductive pad when the solder bump is kept at a melting temperature.

13. A method of detaching an electronic component from

a printed circuit board, comprising:

keeping a solder bump at a melting temperature on a surface of a conductive pad on the printed circuit board under the electronic component; and

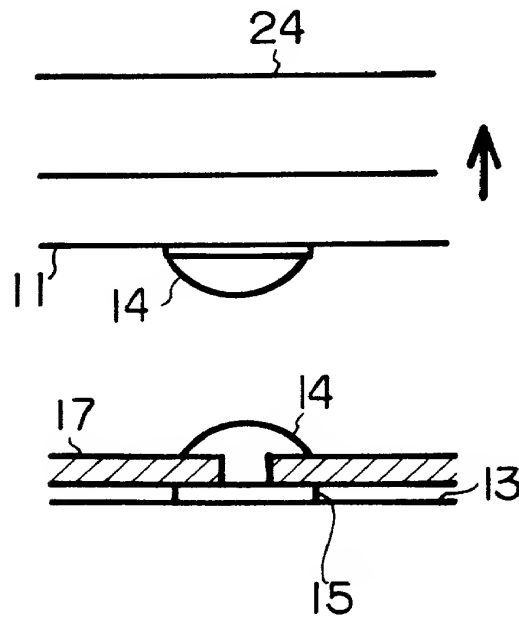
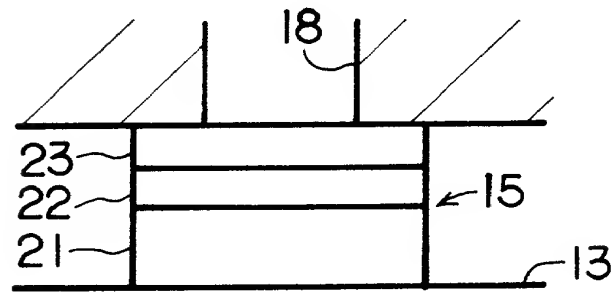
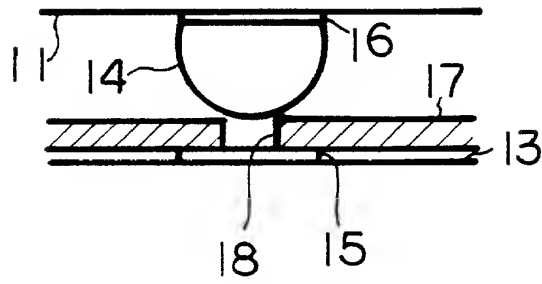
displacing a wall defined in an insulated film between the printed circuit board and the electronic component so as to surround the solder bumps.

14. The method of detaching according to claim 13, wherein the insulated film is displaced relative to the conductive pad.

15. The method of detaching according to claim 13, wherein the insulated film is displaced relative to the electronic component.

ABSTRACT OF THE DISCLOSURE

A printed circuit board unit comprises an insulated film disposed between a printed circuit board and an electronic component so as to define a through hole for receiving the solder bump. The through hole may be designed to form a constriction in the solder bump. Electric connection can reliably be established between the printed circuit board and the electronic component since the solder bump is allowed to penetrate through the through hole in the insulated film. When the insulated film is brought away from the printed circuit board, the insulated film serves to tear the solder bump in two pieces at the constriction, so that the electronic component can easily be detached from the printed circuit board.



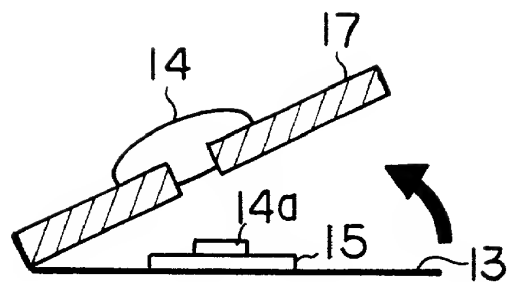


FIG. 7

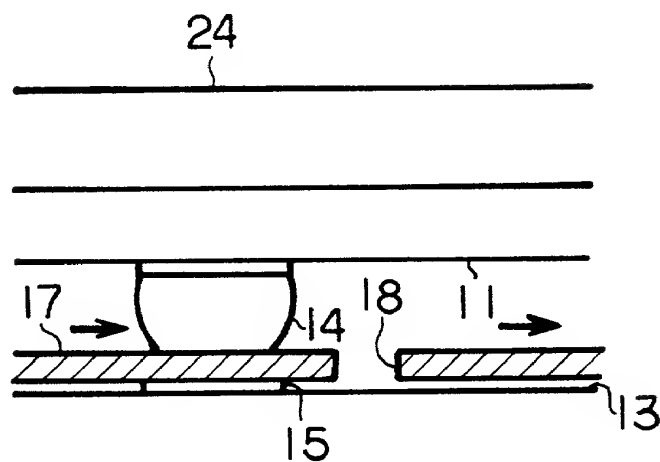


FIG. 8

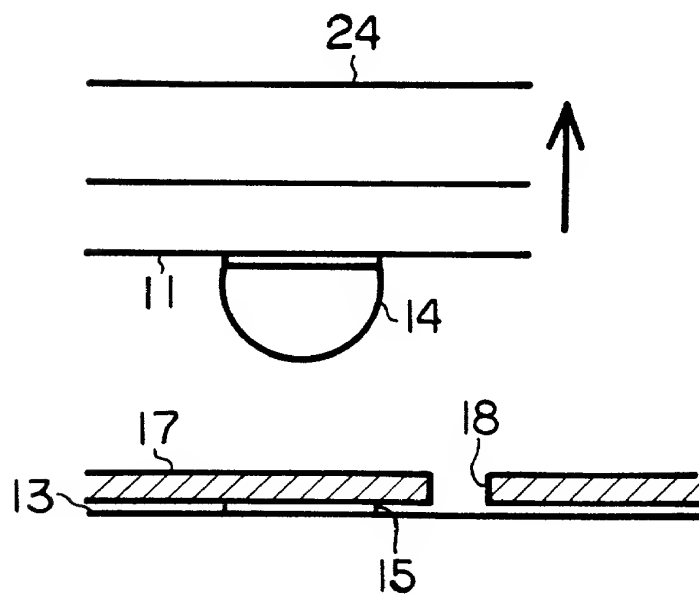


FIG. 9

006260" 8698460

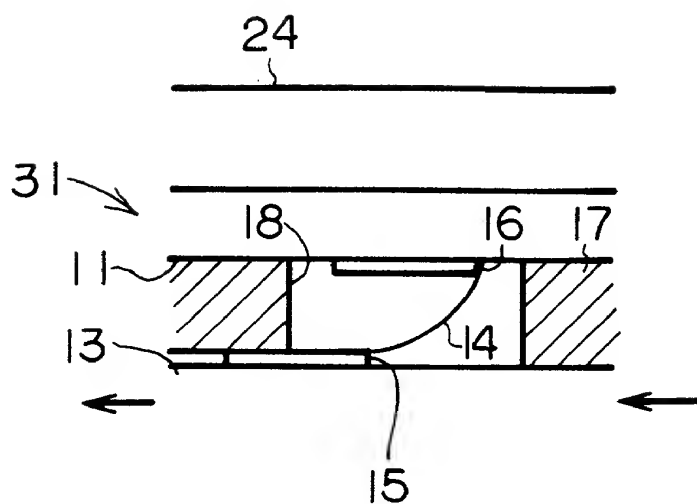


FIG. 13

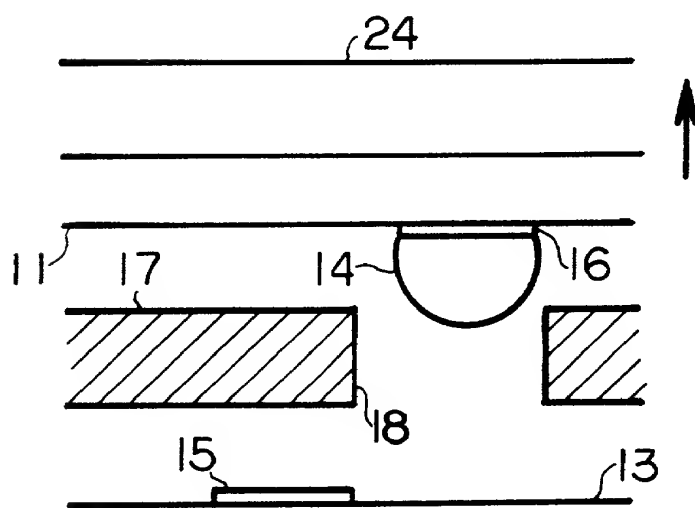


FIG. 14



FIG. 16



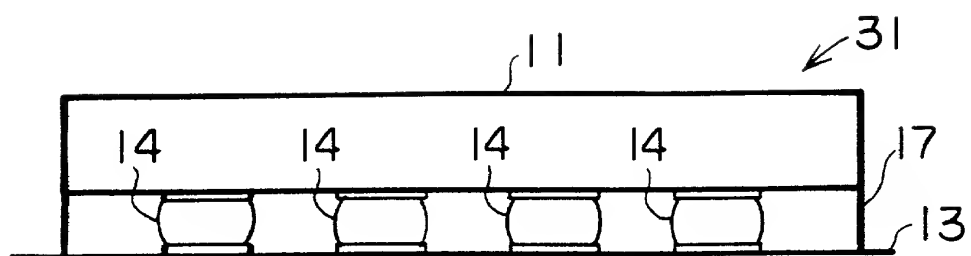


FIG. 17

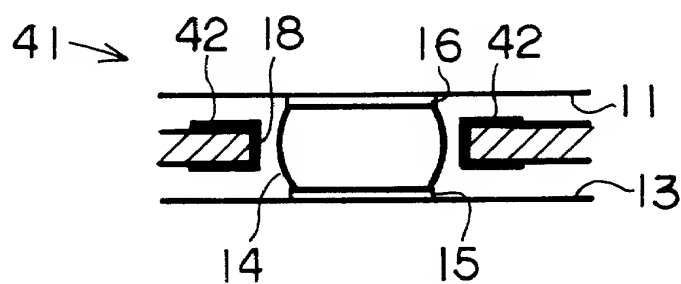


FIG. 18

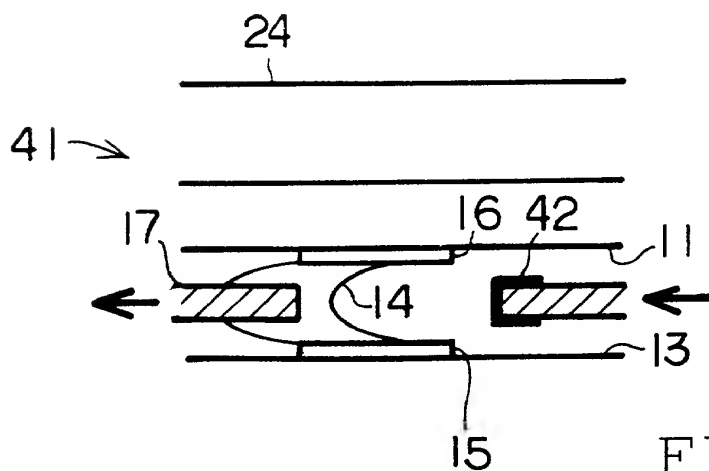


FIG. 19

| Mean (SD) | | Range | | Significance | | |
|-----------------------------------|------------|------------|----------|--------------|------|-----|
| Control | Case | Control | Case | Control | Case | |
| 1. Age (yr) | 10.5 (1.2) | 10.5 (1.2) | 9.0-12.0 | 9.0-12.0 | 0.8 | 0.8 |
| 2. Sex (M/F) | 10/10 | 10/10 | 10/10 | 10/10 | 0.8 | 0.8 |
| 3. Duration of illness (yr) | 1.5 (1.0) | 1.5 (1.0) | 0.5-3.0 | 0.5-3.0 | 0.8 | 0.8 |
| 4. Family history of epilepsy (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 5. History of trauma (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 6. History of infection (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 7. History of stroke (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 8. History of tumor (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 9. History of surgery (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 10. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 11. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 12. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 13. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 14. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 15. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 16. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 17. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 18. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 19. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 20. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 21. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 22. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 23. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 24. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 25. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 26. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 27. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 28. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 29. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 30. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 31. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 32. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 33. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 34. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 35. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 36. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 37. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 38. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 39. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 40. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 41. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 42. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 43. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 44. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 45. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 46. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 47. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 48. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 49. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 50. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 51. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 52. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 53. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 54. History of smoking (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 55. History of drug use (%) | 10 | 10 | 10 | 10 | 0.8 | 0.8 |
| 56. History of alcohol use (%) | 10 | 10 | 10 | 10 | 0.8 | 0. |

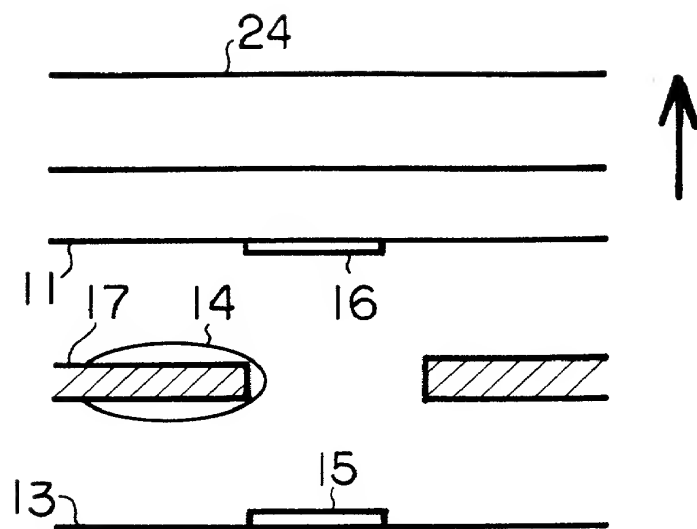


FIG. 20

Docket No. _____

Declaration and Power of Attorney for U.S. Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。 As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled
Printed Circuit Board Unit
With Detachment Mechanism
For Electronic Component

上記発明の明細書（下記の欄でx印がついていない場合は、本書に添付）は、

the specification of which is attached hereto unless the following box is checked:

☐ 月 日に提出され、米国出願番号または特許協定条約国際出願番号を _____ とし、
 （該当する場合） _____ に訂正されました。

☐ was filed on _____
 as United States Application Number or
 PCT International Application Number
 _____ and was amended on
 _____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration (日本語宣言書)

私は、米国法典第35編119条(a)-(d)項又は365条(b)項に基づき下記の、米国外の国の少なくとも一カ国を指定している特許協力条約365(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

Prior Foreign Application(s)

外国での先行出願
11-247121

(Number)
(番号)

Japan

(Country)
(国名)

(Number)
(番号)

(Country)
(国名)

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed

優先権主張なし

1/9/1999

(Day/Month/Year Filed)
(出願年月日)

(Day/Month/Year Filed)
(出願年月日)

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(Application No.)
(出願番号)

(Filing Date)
(出願日)

(Application No.)
(出願番号)

(Filing Date)
(出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国外特許出願に記載された権利、又は米国を指定している特許協力条約365条(c)に基づき権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国外特許出願に開示されていない限り、その先行米国外出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.)
(出願番号)

(Filing Date)
(出願日)

(Status: Patented, Pending, Abandoned)
(現況: 特許許可済、係属中、放棄済)

(Application No.)
(出願番号)

(Filing Date)
(出願日)

(Status: Patented, Pending, Abandoned)
(現況: 特許許可済、係属中、放棄済)

私は、私自身の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じることに基づき表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行えば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration
(日本語宣言書)

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手続きを米特許商標局に対して遂行する弁理士または代理人
として、下記の者を指名いたします。(弁理士、または代理
人の氏名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint
the following attorney(s) and/or agent(s) to prosecute this
application and transact all business in the Patent and Trademark
Office connected therewith (list name and registration number)
See list of attorneys and/or agents on page 5.

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| 第二共同発明者 | 日付 | Second inventor's signature Date |
| | | |
| 住所 | Residence | |
| | | |
| 国籍 | Citizenship | |
| | | |
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| | | |

(第三以降の共同発明者についても同様に記載し、署名をす
ること)

(Supply similar information and signature for third and subsequent
joint inventors.)

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